February 2013

National Listing of Fish Advisories NEWSLETTER

US EPA ARCHIVE DOCUMENT

Recent Advisory News

Kansas issues 2013 fish consumption advisories

The Kansas Department of Health, Kansas Department of Wildlife, and Parks and Tourism has issued revised fish consumption advisories for 2013. The advisories identify types of fish or other aquatic animals that should be eaten in limited quantities or, in some cases, avoided altogether because of contamination. They also provide general advice to aid the public in making informed decisions about the benefits and the risks associated with eating locally caught fish from Kansas waters. More information on Kansas fish advisories can be found at: http://www.kdwpt.state.ks.us/news/Fishing
Link to original article: http://www.kdheks.gov/news/web_archives/2013/01082013a.htm

Source: Kauffman, Ron and Rucker, Ashton. Kansas Department of Health and Environment. 1/7/2013.

Mercury watch in Wyoming fish

The Wyoming Game and Fish Department and the Wyoming Department of Health are advising the public to make informed decisions about the amount of locally caught fish that they consume. The agencies are reporting that although mercury is being detected in fish across the state, the levels are generally low enough to allow moderate consumption. Wyoming recommends that mothers and soon-to-be mothers abide by the guidelines as mercury is known to have detrimental effects on growing fetuses and brain development in children. Specific recommendations for Wyoming fish consumption can be found at: http://wgfd.wyo.gov/web2011/fishing-1001093.aspx
Link to original article: http://www.powelltribune.com/news/item/10519-mercury-watch-in-wyoming-fish

Source: Mathers, Gib. Powell Tribune. Wyoming. 1/4/2013.

New report on global mercury hotspots was released by the International POPs Elimination Network and the Biodiversity Research Institute in January

A recently released report provides new data on global mercury contamination. The study, conducted by the International POPs Elimination Network (IPEN) and Biodiversity Research Institute was designed to raise awareness about global mercury pollution, identify and characterize biological mercury hotspots around the world, and explore how a proposed United Nations Environment Programme treaty might affect mercury pollution at these hotspots. The data in the report represent 108 fish samples from 9 countries and 152 human hair samples from 8 countries. Among other findings, the study revealed that 84% of the fish collected for the project exceeded EPA's dose-based consumption guideline of 0.22 ppm, corresponding to consumption of not more than one meal per month. For more information on the study and IPEN, go to http://www.ipen.org/index.html.
Link to original report: http://www.briloon.org/uploads/documents/hgcenter/gmh/gmhFullReport.pdf

Source: Biodiversity Research Institute and IPEN. 1/9/2013.

Global mercury treaty could make local fish safer

In early January 2013, delegates from 140 nations signed a global treaty to reduce mercury emissions. According to a report issued by the United Nations, the amount of mercury in the atmosphere has doubled in the past century and a large portion of the mercury is anthropogenic. Mercury accumulates in the food chain and provides the basis for fish consumption advisories in many states and territories in North America. The treaty is aimed at reducing human-caused mercury emissions from smokestacks, gold mining and other sources. James Hurley, project director of the University of Wisconsin Water Resources Institute, said that results may be seen quickly if and when the treaty yields mercury reduction. Hurley's research has found that mercury levels in fish drop shortly after the mercury level in a lake goes down – within a year for smaller fish and soon after for bigger fish. Efforts to reduce mercury in fish at a state level in Minnesota have been in place for more than a decade, but these local efforts have not yielded significant results in Minnesota lakes as mercury travels on a larger scale. The treaty is the first ever global treaty to reduce mercury emissions and it is hoped that the results will be widespread.
Link to original article: http://www.duluthnewstribune.com/event/article/id/256848/

Source: Myers, John. Duluth News Tribune. 1/27/2013.

Recent Publications

Please note: The following abstracts are reprinted verbatim unless otherwise noted.

Myocardial infarction in relation to mercury and fatty acids from fish: A risk-benefit analysis based on pooled Finnish and Swedish data in men

BACKGROUND: Exposure to methylmercury from fish has been associated with increased risk of myocardial infarction (MI) in some studies. At the same time, marine n-3 (omega-3) PUFAs are an inherent constituent of fish and are regarded as beneficial. To our knowledge, no risk-benefit model on the basis of data on methylmercury, PUFA, and MI risk has yet been presented. OBJECTIVE: The objective of this study was to describe how exposure to both marine n-3 PUFAs and methylmercury relates to MI risk by using data from Finland and Sweden. DESIGN: We used matched case-control sets from Sweden and Finland that were nested in population-based, prospective cohort studies. We included 361 men with MI from Sweden and 211 men with MI from Finland. MI risk was estimated in a logistic regression model with the amount of mercury in hair (hair-Hg) and concentrations of n-3 PUFAs (EPA and DHA) in serum (S-PUFA) as independent variables. RESULTS: The median hair-Hg was 0.57 μg/g in Swedish and 1.32 μg/g in Finnish control subjects, whereas the percentage of S-PUFA was 4.21% and 3.83%, respectively. In combined analysis, hair-Hg was associated with higher ($P = 0.005$) and S-PUFA with lower ($P = 0.011$) MI risk. Our model indicated that even a small change in fish consumption (i.e., by increasing S-PUFA by 1%) would prevent 7% of MIs, despite a small increase in mercury exposure. However, at a high hair-Hg, the modeled beneficial effect of PUFA on MI risk was counteracted by methylmercury. CONCLUSIONS: Exposure to methylmercury was associated with increased risk of MI, and higher S-PUFA concentrations were associated with decreased risk of MI. Thus, MI risk may be reduced by the consumption of fish high in PUFAs and low in methylmercury.

Source: Wennberg, M., U. Stromberg, et al. (2012). "Myocardial infarction in relation to mercury and fatty acids from fish: A risk-benefit analysis based on pooled Finnish and Swedish data in men." Am J Clin Nutr 96(4): 706-713.

Mercury in tropical and subtropical coastal environments

Anthropogenic activities influence the biogeochemical cycles of mercury, both qualitatively and quantitatively, on a global scale from sources to sinks. Anthropogenic processes that alter the temporal and spatial patterns of sources and cycling processes are changing the impacts of mercury contamination on aquatic biota and humans. Human exposure to mercury is dominated by the consumption of fish and products from aquaculture operations. The risk to society and to ecosystems from mercury contamination is growing, and it is important to monitor these expanding risks. However, the extent and manner to which anthropogenic activities will alter mercury sources and biogeochemical cycling in tropical and sub-tropical coastal environments is poorly understood. Factors as (1) lack of reliable local/regional data; (2) rapidly changing environmental conditions; (3) governmental priorities and; (4) technical actions from supra-national institutions, are some of the obstacles to overcome in mercury cycling research and policy formulation. In the tropics and sub-tropics, research on mercury in the environment is moving from an exploratory "inventory" phase towards more process-oriented studies. Addressing biodiversity conservation and human health issues related to mercury contamination of river basins and tropical coastal environments are an integral part of para-

Conferences

Society of Toxicology 52nd Annual Meeting and ToxExpo
March 10-14, 2013, San Antonio, Texas
http://www.toxicology.org/AI/MEET/AM2013/

International Conference on Mercury as a Global Pollutant
July 28-August 2, 2013, Edinburgh, Scotland
http://www.mercury2013.com/

International Society of Exposure Science (ISES)-23rd Annual Meeting
August 20-23, 2013, Basel, Switzerland
http://www.isesweb.org/Meetings/mtgs_fut.htm

American Fisheries Society 143rd Annual Meeting
September 8 12, 2013, Little Rock, Arkansas
http://afs2013.com/

The Society of Environmental Toxicology and Chemistry (SETAC) North America 34th Annual Meeting
November 17-21, 2013, Nashville, Tennessee
http://www.setac.org/events/event_details.asp?id=244644

graph 221 of the United Nations document "The Future We Want" issued in Rio de Janeiro in June 2012.

Source: Costa, M. F., W. M. Landing, et al. (2012). "Mercury in tropical and subtropical coastal environments." Environ Res 119: 88-100.

Mercury in Arctic marine ecosystems: Sources, pathways and exposure

Mercury in the Arctic is an important environmental and human health issue. The reliance of Northern Peoples on traditional foods, such as marine mammals, for subsistence means that they are particularly at risk from mercury exposure. The cycling of mercury in Arctic marine systems is reviewed here, with emphasis placed on the key sources, pathways and processes which regulate mercury levels in marine food webs and ultimately the exposure of human populations to this contaminant. While many knowledge gaps exist limiting our ability to make strong conclusions, it appears that the long-range transport of mercury from Asian emissions is an important source of atmospheric Hg to the Arctic and that mercury methylation resulting in monomethylmercury production (an organic form of mercury which is both toxic and bioaccumulated) in Arctic marine waters is the principal source of mercury incorporated into food webs. Mercury concentrations in biological organisms have increased since the onset of the industrial age and are controlled by a combination of abiotic factors (e.g., monomethylmercury supply), food web dynamics and structure, and animal behavior (e.g., habitat selection and feeding behavior). Finally, although some Northern Peoples have high mercury concentrations of mercury in their blood and hair, harvesting and consuming traditional foods have many nutritional, social, cultural and physical health benefits which must be considered in risk management and communication.

Source: Kirk, J. L., I. Lehnherr, et al. (2012). "Mercury in Arctic marine ecosystems: Sources, pathways and exposure." Environ Res 119: 64-87.

Chemical contaminants and parasites: Assessment of human health risks associated with consumption of whitefish (*Coregonus clupeaformis*) from two boreal lakes in northern Saskatchewan, Canada

In Canada there is increasing concern about potential effects of industrial activities on wildlife and human health. In an interdisciplinary study concentrations of inorganic (metals, metalloids) and organic (PCBs, organochlorine pesticides) contaminants, and parasitic infections of lake whitefish (*Coregonus clupeaformis*) from Montreal and Reindeer lakes, Saskatchewan, were investigated to assess human health risk related to fish

consumption. In both lakes contamination of fish with chemical substances and compounds, respectively, were very low and often close to detection limits. Lake whitefish parasite communities consisted of 15 (Montreal Lake) and 12 (Reindeer Lake) species most of which were found in the intestinal tract. Many parasite species showed seasonal differences in prevalence and/or mean intensity of infection. None of the identified parasites are known to be human-pathogenic and overall, whitefish from both locations can be considered safe and healthy food. Nevertheless, women of child-bearing age and young children should limit their consumption to 3 and 2 meals, respectively, of Reindeer Lake whitefish per week to minimize potentially harmful exposure to mercury. As well, intestines of Montreal Lake fish should be removed prior to fish consumption if large parasite cysts containing a yet unidentified cestode species are detected.

Source: Hursky, O. and M. Pietrock (2012). "Chemical contaminants and parasites: Assessment of human health risks associated with consumption of whitefish (*Coregonus clupeaformis*) from two boreal lakes in northern Saskatchewan, Canada." Sci Total Environ 424: 97-103.

Evidence on the human health effects of low-level methylmercury exposure

BACKGROUND: Methylmercury (MeHg) is a known neuro-toxicant. Emerging evidence indicates it may have adverse effects on the neurologic and other body systems at common low levels of exposure. Impacts of MeHg exposure could vary by individual susceptibility or be confounded by beneficial nutrients in fish containing MeHg. Despite its global relevance, synthesis of the available literature on low-level MeHg exposure has been limited. OBJECTIVES: We undertook a synthesis of the current knowledge on the human health effects of low-level MeHg exposure to provide a basis for future research efforts, risk assessment, and exposure remediation policies worldwide. DATA SOURCES AND EXTRACTION: We reviewed the published literature for original human epidemiologic research articles that reported a direct biomarker of mercury exposure. To focus on high-quality studies and those specifically on low mercury exposure, we excluded case series, as well as studies of populations with unusually high fish consumption (e.g., the Seychelles), marine mammal consumption (e.g., the Faroe Islands, circumpolar, and other indigenous populations), or consumption of highly contaminated fish (e.g., gold-mining regions in the Amazon). DATA SYNTHESIS: Recent evidence raises the possibility of effects of low-level MeHg exposure on fetal growth among susceptible subgroups and on infant growth in the first 2 years of life. Low-level effects of MeHg on neurologic outcomes may differ by age, sex, and timing of exposure. No clear pattern has been observed for cardiovascular disease (CVD) risk across populations or for specific CVD end points. For the few studies evaluating immunologic effects associated with MeHg, results have been inconsistent. CONCLUSIONS: Studies targeted at identifying potential mechanisms of low-level MeHg effects and characterizing individual susceptibility, sexual dimorphism, and non-linearity in dose response would help guide future prevention, policy, and regulatory efforts surrounding MeHg exposure.

Source: Karagas, M. R., A. L. Choi, et al. (2012). "Evidence on the human health effects of low-level methylmercury exposure." Environ Health Perspect 120(6): 799-806.

Plasma and dietary omega-3 fatty acids, fish intake, and heart failure risk in the Physicians' Health Study

BACKGROUND: Data on the relation of plasma and dietary omega-3 (n-3) fatty acids (FAs) with heart failure (HF) risk have been inconsistent. OBJECTIVE: We evaluated the relation of n-3 FAs with HF in US male physicians. DESIGN: We used nested case-control (n = 1572) and prospective cohort study designs (n = 19,097). Plasma phospholipid n-3 FAs were measured by using gas chromatography, and food-frequency questionnaires were used to assess dietary n-3 FAs and fish intake. Incident HF was ascertained via annual follow-up questionnaires and validated in a subsample. RESULTS: The mean age was 58.7 y at blood collection. In a multivariable model, plasma α-linolenic acid (ALA) was associated with a lower risk of HF in a nonlinear fashion (P-quadratic trend = 0.02), and the lowest OR was observed in quintile 4 (0.66; 95% CI: 0.47, 0.94). Plasma EPA and DHA were not associated with HF, whereas plasma docosapentaenoic acid (DPA) showed a nonlinear inverse relation with HF for quintile 2 (OR: 0.55; 95% CI: 0.39, 0.79). Dietary marine n-3 FAs showed a trend toward a lower risk of HF in quintile 4 (HR: 0.81; 95% CI: 0.64, 1.02) and a nonlinear pattern across quintiles. Fish intake was associated with a lower risk of HF, with RRs of ~0.70 for all categories of fish consumption greater than one serving per month. CONCLUSIONS: Our data are consistent with an inverse and nonlinear relation of plasma phospholipid ALA and DPA, but not EPA or DHA, with HF risk. Fish consumption greater than once per month was associated with a lower HF risk.

Source: Wilk, J. B., M. Y. Tsai, et al. (2012). "Plasma and dietary omega-3 fatty acids, fish intake, and heart failure risk in the Physicians' Health Study." Am J Clin Nutr 96(4): 882-888.

Fish consumption, omega-3 fatty acids and risk of heart failure: A meta-analysis

BACKGROUND & AIMS: While marine omega-3 fatty acids have been associated with a lower mortality in heart failure patients, data on omega-3 and incident heart failure are inconsistent. We systematically reviewed the evidence on the association of omega-3 fatty acids and fish intake with the incidence of heart failure in this meta-analysis. METHODS: We identified relevant studies by searching MEDLINE and EMBASE databases up to August 31, 2011 without restrictions and by reviewing reference lists from retrieved articles. RESULTS: A total of 176,441 subjects and 5480 incident cases of heart failure from 7 prospective studies were included in this analysis. Using random effect model, the pooled relative risk for heart failure comparing the highest to lowest category of fish intake was 0.85 (95% CI; 0.73-0.99), p = 0.04; corresponding value for marine omega-3 fatty acids was 0.86 (0.74-1.00), p = 0.05. There was no evidence for heterogeneity across studies of fish consumption (I^2 = 8%). In contrast, there was modest heterogeneity for omega-3 fatty acid analysis (I^2 = 44%). Lastly, there was no evidence for publication bias. CONCLUSIONS: This meta-analysis is consistent with a lower risk of heart failure with intake of marine omega-3 fatty acids. These observational findings should be confirmed in a large randomized trial.

Source: Djousse, L., A. O. Akinkuolie, et al. (2012). "Fish consumption, omega-3 fatty acids and risk of heart failure: A meta-analysis." Clin Nutr 31(6): 846-853.

Knowledge and barriers relating to fish consumption in older Australians

Among 854 Australians ≥51 years of age, this cross-sectional survey explored knowledge regarding finfish consumption, sources of information on fish and omega 3 fatty acids, what barriers limit finfish consumption and what factors predict its consumption. The survey consisted of a validated quantitative fish frequency questionnaire with additional questions on barriers and knowledge relating to finfish. Twelve percent of respondents consumed oily fish ≥2 times per week. Cost was the most frequently (37%) reported barrier for fresh finfish consumption. In multiple regression analysis, respondents' exposure to multiple sources of information (odds ratio (95% confidence interval): 1.135 (1.01, 1.28), who correctly identified the current recommendations for fish consumption; 1.87 (1.13, 3.07), agreed that fish improves general health; 3.57 (1.13, 11.30), and reported fewer barriers towards canned fish consumption; 0.59 (0.41, 0.84) were more likely to consume ≥2 servings of fresh finfish per week. Education and health programs need to be readily available highlighting current recommendations for fish consumption and how targets can be achieved. Meal plans with various finfish/seafood and amounts of omega 3 fatty acids required to achieve recommendations, and within a suitable budget, is likely to be an important strategy to target older consumers to increase consumption.

Source: Grieger, J. A., M. Miller, et al. (2012). "Knowledge and barriers relating to fish consumption in older Australians." Appetite 59(2): 456-463.

Lipid and fatty acid composition, and persistent organic pollutant levels in tissues of migrating Atlantic bluefin tuna (*Thunnus thynnus*, L.) broodstock

Lipid class, fatty acid and POP levels were measured in migrating Atlantic bluefin tuna (ABT) tissues caught off the Barbate coast, Spain. Tissue lipids were largely characterized by triacylglycerol, reflecting large energy reserves accumulated prior to reproductive migration. Fatty acid compositions of muscle, liver and adipose exhibited similar profiles, whereas gonads showed a higher affinity for docosahexaenoic acid. Tissue POP concentrations correlated positively with percentage triacylglycerol and negatively with polar lipids. Highest POP concentrations were in adipose and lowest in gonads, reflecting lipid content. DL-PCBs contributed most to total PCDD/F + DL-PCB levels, with mono-ortho concentrations higher in tissues, whereas non-ortho PCBs contributed greater WHO-TEQs due to differences in TEFs. PBDE47 was the most prominent BDE congener in tissues, probably through biotransformation of BDE99 and other higher brominated congeners. The perceived POP risk from ABT consumption should be balanced by the well-established beneficial effects on human health of omega-3 fatty acids.

Source: Sprague, M., J. R. Dick, et al. (2012). "Lipid and fatty acid composition, and persistent organic pollutant levels in tissues of migrating Atlantic bluefin tuna (*Thunnus thynnus, L.)* broodstock." Environ Pollut 171: 61-71.

Evaluation of a public health intervention to lower mercury exposure from fish consumption in Bermuda

OBJECTIVES: To assess the efficacy of a public health intervention to reduce blood mercury (Hg) concentration

levels in pregnant Bermudian women. METHODS: In 2003, we conducted a study entitled "Prenatal exposure of the Bermudian Population to Environmental Contaminants" which provided Bermuda's first baseline data on prenatal exposure to several environmental contaminants, including Hg. The mean Hg concentration from 42 healthy newborns measured in umbilical cord blood was 41.3 nmol/L, ranging from 5-160 nmol/L. This concentration was much higher than expected, being approximately 8 times the general levels found in Canada and the U.S. Furthermore, we estimated that 85% of total Hg measured was in the form of methylmercury (MeHg), indicating that seafood consumption was the primary source of Hg exposure during pregnancy in Bermuda. Locally sourced seafood was identified as the most significant possible contributory source of Hg exposure. In 2005 the authors began a complementary research programme to study the levels of Hg in local commercial fish species. Coming out of this research were specific local fish consumption guidelines issued by the Department of Health advising pregnant women to avoid those local fish species found to be high in Hg while still encouraging consumption of fish species having lower Hg levels. RESULTS: In 2010, under another research initiative, we returned to Bermuda to carry out another evaluation of Hg in human blood. Hg was measured in the blood of 49 pregnant women. The arithmetic mean Hg blood concentration was 6.6 nmol/L and the geometric mean 4.2 nmol/L. The maximum concentration found was 24 nmol/L. CONCLUSIONS: Hg exposure of Bermudian pregnant women has dropped significantly by a factor of around 5 since the fetal cord blood study in 2003.

Source: Dewailly, E., P. Rouja, et al. (2012). "Evaluation of a public health intervention to lower mercury exposure from fish consumption in Bermuda." PLoS One 7(10): e47388.

Levels of mercury and polychlorobiphenyls in commercial food in Siena Province (Tuscany, Italy) in the period 2001–2010

In this paper, the presence and amount of mercury and polychlorobiphenyls (PCBs) were determined in more than 1000 food items collected monthly in the period 2001–2010 in commercial food shops in Siena (Tuscany, Italy), in order to assess risk to humans due to food consumption. The overall results clearly show a strong difference in concentration of the two contaminants between foods from the terrestrial trophic web and those from the marine trophic web. Particular attention was paid to study the Mediterranean swordfish (*Xiphias gladius*)and bluefin tuna (*Thunnus thynnus*) because anthropic impact on these species is great due to their topmost position introphicwebs; thus it is very important to know their health status and evaluate their toxicity for humans. Many samples of bluefin tuna and swordfish show mercury levels higher than 0.5 mg/kg f.w.,which is the maximum level set by the European Commission (EC, Regulation n. 1881/2006) for most fish species. Taking into account the important nutritional contribution that fish makes to the diet, it is advisable that women of childbearing age, pregnant and breastfeeding women as well as young children select fish from a wide range of species, without giving undue preference to large predatory fish such as swordfish and tuna. In any case, it is interesting to note a significant decrease in levels of both mercury and PCBs in bluefin tuna and swordfish found in the Sienese market over the course of the past ten years.

Source: Focardi, S. (2012). "Levels of mercury and polychlorobiphenyls in commercial food in Siena Province (Tuscany, Italy) in the period 2001–2010." Microchemical Journal 105: 60-64.

A quantitative synthesis of mercury in commercial seafood and implications for exposure in the United States

BACKGROUND: Mercury (Hg) is a toxic metal that presents public health risks through fish consumption. A major source of uncertainty in evaluating harmful exposure is inadequate knowledge of Hg concentrations in commercially important seafood. OBJECTIVES: We examined patterns, variability, and knowledge gaps of Hg in common commercial seafood items in the United States and compared seafood Hg concentrations from our database to those used for exposure estimates and consumption advice. METHODS: We developed a database of Hg concentrations in fish and shellfish common to the U.S. market by aggregating available data from government monitoring programs and the scientific literature. We calculated a grand mean for individual seafood items, based on reported means from individual studies, weighted by sample size. We also compared database results to those of federal programs and human health criteria [U.S. Food and Drug Administration Hg Monitoring Program (FDA-MP), U.S. Environmental Protection Agency (EPA)]. RESULTS: Mean Hg concentrations for each seafood item were highly variable among studies, spanning 0.3-2.4 orders of magnitude. Farmed fish generally had lower grand mean Hg concentrations than their wild counterparts, with wild seafood having 2- to 12-fold higher concentrations, depending on the seafood item. However, farmed fish are relatively understudied, as are specific seafood items and seafood imports from Asia and South America. Finally, we found large discrepancies between mean Hg concentrations esti-

mated from our database and FDA-MP estimates for most seafood items examined. CONCLUSIONS: The high variability in Hg in common seafood items has considerable ramifications for public health and the formulation of consumption guidelines. Exposure and risk analyses derived from smaller data sets do not reflect our collective, available information on seafood Hg concentrations.

Source: Karimi, R., T. P. Fitzgerald, et al. (2012). "A quantitative synthesis of mercury in commercial seafood and implications for exposure in the United States." Environ Health Perspect 120(11): 1512-1519.

Sustaining seafood for public health

Concern about the collapse of overexploited fish populations and the safety of consuming seafood can complicate determining what types of fish are best to eat. In recent years, public attention has become increasingly focused on oceanic environmental contaminants, which may be toxic to seafood consumers in sufficient doses. Laudable education campaigns have been established to inform consumers about seafood choices that are sustainable, and to provide information on which fish are deemed safe for human consumption. We found that unsustainable seafood items also present higher health risks (as indexed by mercury concentrations) and do not necessarily provide greater health benefits (as indexed by omega-3 fatty acid concentrations) as compared with sustainable seafood items. Our results have broad implications for identifying effective approaches for informing consumers about the health risks and benefits of different seafood choices, while simultaneously addressing the ecological consequences of fishing and fish farming.

Source: Gerber, L. R., R. Karimi, et al. (2012). "Sustaining seafood for public health." Frontiers in Ecology and the Environment 10(9): 487-493.

Persistent organic pollutants in the Scheldt estuary: Environmental distribution and bioaccumulation

Levels of polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and organochlorine pesticides (OCPs) were determined in the sediment and several species (European flounder, *Platichthys flesus*; common sole, *Solea solea*; Chinese mitten crab, *Eriocheir sinensis*; shore crab, *Carcinus maenas*; brown shrimp, *Crangon crangon*; blue mussel, *Mytilus edulis* and bristle worms, Polychaeta) from 7 locations in the Scheldt estuary (SE, the Netherlands-Belgium). Overall POP levels in the sediment were low. The average PCB and PBDE concentrations were respectively 31.5 and 115 ng/g dry weight (dw). Highest sediment loads were measured in the vicinity of Antwerp (368 ng PCBs/g dw), a location with intense harbor and industrial activities. Pollution concentrations in the tissues of biota were species-specific. Blue mussels contained the highest lipid concentrations (2.74+/-0.55%) and reached the highest contamination levels (from 287 to 1688 ng PCBs/g ww, from 2.09 to 12.4 ng PBDEs/g ww). Lowest tissue loads were measured in brown shrimp (from 3.27 to 39.9 ng PCBs/g ww, from 0.05 to 0.47 ng PBDEs/g ww). The PCB congener profile in most of the species was similar with the pattern found in the sediment. PCB 153 was the most abundant congener (16.5-25.7% in biota, 10.4% in sediment). In the sediment, the total amount of PBDEs consisted for more than 99% of BDE 209. Congener BDE 47 had the highest concentrations in all sampled species (38.5-70.1%). Sediment POP loadings and tissue concentrations were poorly correlated, indicating that a simple linear or non-linear relationship is insufficient to describe this relationship, possible caused by the complexity of the bioaccumulation processes and the variability in exposure. Because of the high PCB levels, regular consumption of fish and seafood, especially mussels, from the Scheldt estuary should be avoided.

Source: Van Ael, E., A. Covaci, et al. (2012). "Persistent organic pollutants in the Scheldt estuary: Environmental distribution and bioaccumulation." Environ Int 48: 17-27.

Study on heavy metals levels and its risk assessment in some edible fishes from Bangshi River, Savar, Dhaka, Bangladesh

Concentrations of eight heavy metals (Pb, Cd, Ni, Cr, Cu, Zn, Mn, and As) in the muscles of ten species of fish collected from Bangshi River at Savar in Bangladesh were measured in two different seasons. The concentrations of the studied heavy metals, except Pb in *Corica soborna*, were found to be below the safe limits suggested by various authorities and thus gave no indication of pollution. The present study also showed that, Zn was the most and Cd was the least accumulated metal in the studied fish muscles. ANOVA analysis clearly revealed that there was a significant variation (CI = 95%) of the heavy metal concentrations in different fish species in the Bangshi River. Significant positive correlations between the heavy metal concentrations in fish muscles were also observed in both seasons. From the human health point of view, this study showed that there was no possible health risk to consumers due to intake of studied fishes under the current consumption rate.

Source: Rahman, M. S., A. H. Molla, et al. (2012). "Study on heavy metals levels and its risk assessment in some edible fishes from Bangshi River, Savar, Dhaka, Bangladesh." Food Chem 134(4): 1847-1854.

Assessment of metal status in drainage canal water and their bioaccumulation in *Oreochromis niloticus* fish in relation to human health

The purpose of this study was to assess metal concentrations (Al, Cd, Pb, Hg and Ni) in Sabal drainage canal (Al-Menoufiya Province, River Nile Delta, Egypt) water as well as their accumulation in some selected organs (skin, muscles and kidneys) of *Oreochromis niloticus* fish to evaluate their hazard levels in relation to the maximum residual limits for human consumption. Drainage canal water was found to be heavily polluted with metals which far exceeded the permissible limits. It was found that metals accumulated in organs of *O. niloticus* in concentrations higher than those of canal water. Kidneys of *O. niloticus* contained the highest concentrations of the detected metals, while skin appeared to be the least preferred site for the bioaccumulation of metals as the lowest metals concentrations were detected in this tissue. The present study shows that fish organs contained high levels of metals exceeding the permissible limits values. Metals in muscle of fish were higher than the maximum permissible concentrations for human consumption. Thus, consuming fish caught from drainage canals is harmful to the consumers.

Source: Authman, M. M., H. H. Abbas, et al. (2013). "Assessment of metal status in drainage canal water and their bioaccumulation in *Oreochromis niloticus* fish in relation to human health." Environ Monit Assess 185(1): 891-907.

Freshwater fish-consumption relations with total hair mercury and selenium among women in eastern China

Wild fish from Qiandao Hu, a reservoir in the Zhejiang Province in eastern China, have increased mercury (Hg) concentrations exceeding the World Health Organization's (WHO) recommended guidelines. Due to the importance of freshwater biota in the local cuisine, dietary exposure to increased neurotoxic Hg is a concern in this region. An environmental hair-marker study was undertaken coincident with a cross-sectional epidemiologic study with 50 women age 17-46 years living in a Qiandao Hu fishing village. Diet, occupation, and other possible sources of Hg were recorded by way of questionnaires. Total mercury (THg) and selenium (Se) concentrations were measured in human hair samples and in important market fish species. Fish THg and Se concentrations were increased, with some fish concentrations >200 ng/g THg and 500 ng/g Se (wet weight [ww]). However, the average hair THg was low at 0.76 +/- 0.51 μg/g dry weight, lower than the WHO's no observable-adverse effect level (50 μg/g), whereas the average hair Se was 1.0 μg/g. Hair THg concentration was positively associated with the average mass of fish consumed weekly, indicating that fish consumption is the main contributor to hair THg in this geographic area. The age-related hair THg trend was not linear but instead demonstrated a rapid increase in THg before age 25 years, followed by consistent concentrations in all ages after age 25 years. There was a positive correlation ($p < 0.001$) between molar Se and Hg in the hair samples, suggesting a possible antagonistic relation. This is the first study examining the relation between dietary Hg exposure and hair THg in an eastern China community where freshwater fish, as opposed to marine fish, dominates the cuisine.

Source: Fang, T., K. J. Aronson, et al. (2012). "Freshwater fish-consumption relations with total hair mercury and selenium among women in eastern China." Arch Environ Contam Toxicol 62(2): 323-332.

Reducing methylmercury accumulation in the food webs of San Francisco Bay and its local watersheds

San Francisco Bay (California, USA) and its local watersheds present an interesting case study in estuarine mercury (Hg) contamination. This review focuses on the most promising avenues for attempting to reduce methylmercury (MeHg) contamination in Bay Area aquatic food webs and identifying the scientific information that is most urgently needed to support these efforts. Concern for human exposure to MeHg in the region has led to advisories for consumption of sport fish. Striped bass from the Bay have the highest average Hg concentration measured for this species in USA estuaries, and this degree of contamination has been constant for the past 40 years. Similarly, largemouth bass in some Bay Area reservoirs have some of the highest Hg concentrations observed in the entire US. Bay Area wildlife, particularly birds, face potential impacts to reproduction based on Hg concentrations in the tissues of several Bay species. Source control of Hg is one of the primary possible approaches for reducing MeHg accumulation in Bay Area aquatic food webs. Recent findings (particularly Hg isotope measurements) indicate that the decades-long residence time of particle-associated Hg in the Bay is sufficient to allow significant conversion of even the insoluble forms of Hg into MeHg. Past inputs have been thoroughly mixed throughout this shallow and dynamic estuary. The large pool of Hg already present in the ecosystem dominates the fraction converted to MeHg and accumulating

in the food web. Consequently, decreasing external Hg inputs can be expected to reduce MeHg in the food web, but it will likely take many decades to centuries before those reductions are achieved. Extensive efforts to reduce loads from the largest Hg mining source (the historic New Almaden mining district) are underway. Hg is spread widely across the urban landscape, but there are a number of key sources, source areas, and pathways that provide opportunities to capture larger quantities of Hg and reduce loads from urban runoff. Atmospheric deposition is a lower priority for source control in the Bay Area due to a combination of a lack of major local sources. Internal net production of MeHg is the dominant source of MeHg that enters the food web. Controlling internal net production is the second primary management approach, and has the potential to reduce food web MeHg in some habitats more effectively and within a much shorter time-frame. Controlling net MeHg production and accumulation in the food web of upstream reservoirs and ponds is very promising due to the many features of these ecosystems that can be manipulated. The most feasible control options in tidal marshes relate to the design of flow patterns and subhabitats in restoration projects. Options for controlling MeHg production in open Bay habitat are limited due primarily to the highly dispersed distribution of Hg throughout the ecosystem. Other changes in these habitats may also have a large influence on food web MeHg, including temperature changes due to global warming, sea level rise, food web alterations due to introduced species and other causes, and changes in sediment supply. Other options for reducing or mitigating exposure and risk include controlling bioaccumulation, cleanup of contaminated sites, and reducing other factors (e.g., habitat availability) that limit at-risk wildlife populations.

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Additional Information

For more information about specific advisories within a state, contact the appropriate state agency listed on EPA's NLFA website at http://fishadvisoryonline.epa.gov/Contacts.aspx

For more information about the NLFA or EPA's Fish Advisory Program, contact:

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